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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte ANTON MAUDER and PHILIPP SENG[1]

Appeal 2015-004760
Application 12/269,480
Technology Center 2800

Before ADRIENE LEPIANE HANLON, WESLEY B. DERRICK, and DEBRA L. DENNETT, *Administrative Patent Judges*.

DERRICK, *Administrative Patent Judge*.

DECISION ON APPEAL[2]

This is a decision on an appeal under 35 U.S.C. § 134 from the Examiner's maintained rejection of claims 1, 8–14, 25–32, and 34–37.[3] We have jurisdiction pursuant to 35 U.S.C. § 6.

We AFFIRM.

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[1] Appellants state that the real party in interest is Infineon Technologies Austria AG. Appeal Br. 3.

[2] We refer to the Specification filed November 12, 2008, the Final Office Action mailed June 26, 2014, the Appeal Brief filed November 20, 2014, the Examiner's Answer mailed January 20, 2015, and the Reply Brief filed March 20, 2015.

[3] Pending claims 15–24 stand withdrawn from consideration. Final Act. 1.

BACKGROUND

Appellants' claimed invention relates to a semiconductor diode with an integrated resistor. Spec. Abstract. All independent claims on appeal are directed to a semiconductor diode. Claims 1, 30.

Claim 1 is representative of the claims on appeal.

> 1. A semiconductor diode, comprising:
> a semiconductor body including a front surface and a back surface and including a cathode emitter zone defining the back surface and an anode zone disposed at the front surface which are joined by a pn-junction;
> a diode structure including an anode electrode and a cathode electrode, the anode electrode disposed on the front surface; and
> a resistance layer comprising carbon disposed on and uninterruptedly extending over the entire back surface at the cathode emitter zone of the semiconductor body providing an integrated resistor, the resistance layer having first and second sides opposing one another, the second side facing cathode zone at the back surface and the cathode electrode disposed directly on and entirely covering the first side of the resistance layer; and wherein the resistance layer has a thickness in a range of 50μm to 500μm.

Appeal Br. (Claims Appendix) 15.

Independent claim 30 is likewise directed to a semiconductor diode, particularly one in which the resistance layer comprising carbon is a non-silicon resistance layer. Claims 1, 30.

REJECTIONS

The claims stand rejected under 35 U.S.C. § 103(a):

I. Claims 1, 9, and 25–29 over Mauder[4] in view of Tolonics;[5]

II. Claims 8 and 13 over Mauder in view of Tolonics and Kitagawa;[6]

III. Claim 10 over Mauder in view of Tolonics and Mauder II;[7]

IV. Claims 11 and 12 over Mauder in view of Tolonics and Inoue;[8]

V. Claim 14 over Mauder in view of Tolonics, Kitagawa, and Mauder II;

VI. Claims 30 and 32 over Mauder in view of Kodas;[9]

VII. Claims 31 and 36 over Mauder in view of Kodas and Kitagawa;

VIII. Claim 33 over Mauder in view of Kodas and Mauder II;

IX. Claims 34 and 35 over Mauder in view of Kodas and Inoue; and

X. Claim 37 over Mauder in view of Kodas, Kitagawa, and Mauder II.

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[4] Mauder et al., US 2005/0161746 A1, published July 28, 2005
[5] Tolonics et al., US 2006/0255376 A1, published November 16, 2006.
[6] Kitagawa et al., US 5,162,876, issued November 10, 1992.
[7] Mauder et al., US 2004/0080015 A1, published April 29, 2004.
[8] Inoue et al., US 2002/0081773 A1, published June 27, 2002.
[9] Kodas et al., US 2003/0175411 A1, published September 18, 2003.

DISCUSSION

To prevail in an appeal to this Board, Appellants must adequately explain or identify reversible error in the Examiner's rejection. *See* 37 C.F.R. § 41.37(c)(1)(iv) (2012); *see also In re Jung*, 637 F.3d 1356, 1365–66 (Fed. Cir. 2011) (explaining that even if the Examiner had failed to make a prima facie case, it has long been the Board's practice to require an appellant to identify the alleged error in the examiner's rejection); *In re Chapman*, 595 F.3d 1330, 1338 (Fed. Cir. 2010) ("[T]he burden of showing that the error is harmful normally falls upon the party attacking the agency's determination." (quoting *Shinseki v. Sanders*, 556 U.S. 396, 409 (2009))).

Appellants effectively argue all claims on the basis of independent claim 1 or on the basis of arguments raised as to the rejection of claim 1. Appeal Br. 6–13. We focus our discussion on the arguments as to claim 1 in our decision as to all claims. 37 C.F.R. § 41.37(c)(1)(iv). On this record, we are not persuaded that the Examiner erred reversibly in maintaining the obviousness rejections of the claims over the collective teachings of the cited prior art for the reasons expressed by the Examiner in the Final Office Action and the Answer. We add the following.

Mauder relates to a semiconductor diode 1 (or 1′) comprising an anode 2 and cathode 3 and a semiconductor volume 7 disposed between the anode 2 and cathode 3. Mauder Abstract, Figs. 1, 2. In Figure 1, the semiconductor volume 7 is comprised of a first semiconductor layer 4 (n^+-doped), a second semiconductor 5 (n^--doped), and a third semiconductor layer 6 (p-doped). Mauder ¶ 28, Fig. 1. In Figure 2, the semiconductor volume 7 is comprised of a first semiconductor layer 4 (n^+-doped), a second semiconductor 5 (n-doped), a third semiconductor layer 6 (n^--doped), and a

fourth semiconductor layer 9 (p-doped). Mauder ¶ 37, Fig. 2. A plurality of semiconductor zones 8_1 to 8_4 are disposed within the second semi-conductor layer 5 (or 5′). Mauder ¶ 28, Figs. 1, 2. The Examiner relies on the portion of the semiconductor volume of semiconductor 5 (or 5′) spanned by items 8_1–8_4 and semiconductor 4 as the resistance layer. Final Act. 3; Ans. 2–5.

Tolonics relates to forming integrated circuits. The Examiner relies on Tolonics for its disclosure that carbon and/or germanium can be incorporated into the lattice structure of crystalline silicon to change the local resistance allowing adjustment of the resistance value without changes in the layout and lithography masks. Final Act. 3–4 (citing Tolonics ¶¶ 15, 38); Tolonics Abstract. The Examiner further determines that a carbon resistor would restrict current and power into the device slowing the commutation process and, thus, protect the diode in extreme conditions. Ans. 4.

The Examiner *de facto* concludes it would have been obvious to one of ordinary skill in the art at the time of the invention to have included carbon in a resistance layer of Mauder in order to adjust the resistance of the resistance layer, including for the purpose of slowing the commutation process, in a manner that is easier to manufacture and customize. Final Act. 3–4; Ans. 4–5.

As to the thickness of the resistance layer set forth in claim 1, the Examiner *de facto* finds that the thickness is a result effective variable in the determination that the thickness has an effect on, *inter alia*, the resistance layer diode reverse voltage and device thickness (Final Act. 4), as well as, operational characteristics including thermal capacity (Ans. 5–6). Further, in response to Appellants' contentions, the Examiner determines that the

thickness of the resistance layer of Mauder ranges from 3.2 μm to 50 μm and that this range, at the upper end, overlaps with the claimed range of 50 μm to 500 μm. Ans. 5; *see also* Mauder ¶ 29 (disclosing a thickness a of semiconductor zones 8_1 to 8_4 as 3 to 20 μm and a thickness b of layer 4 as 0.2 to 30 μm). As there is an overlap of the disclosed and claimed ranges, the claimed range is also prima facie obvious on that basis. Ans. 5.

Appellants proffer four general arguments.

First, Appellants argue that the Examiner erred in finding that the portion of the semiconductor volume spanned by items 8_1–8_4 *and* 4 as the resistance layer because Mauder "explicitly states that '[t]he p-type zones formed by the semiconductor zones 8_1 to 8_4 . . . [are] represented by the resistance R (actually 'R_0") in the equivalent circuit diagram" and that Mauder "illustrates the resistor R_0 as extending between junction J2 and J3" where J2 and J3 are the junctions between semiconductor zones 8_1 to 8_4 and semiconductor layers 5 and 4, respectively. Appeal Br. 6–7 (citing Mauder ¶¶ 30, 34, Fig. 1). Appellants contend that because the region corresponding to the resistance R_0 for the disclosed diode corresponds to only that spanned by semiconductor zones 8_1 to 8_4, semiconductor layer 4 cannot be part of the resistance layer and thus Mauder fails to teach or suggest a resistance layer disposed directly on the cathode electrode. Appeal Br. 7.

Appellants' argument is not persuasive that the Examiner erred reversibly. As highlighted by the Examiner's comments (Ans. 2–3), there is a reasonable basis to consider first semiconductor layer 4 as part of a resistance layer for diode J1 where semiconductor layers 4 and 5 (or 5′) are formed of normal ohmic materials and Appellants fail to direct us to any basis for requiring the claimed resistance layer to be formed of a single,

unitary layer of material. *See, e.g.*, *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379 (Fed. Cir. 2007) (It is well established that "the PTO must give claims their broadest reasonable interpretation consistent with the specification."). As to Appellants' arguments grounded on the resistance R_0 for the disclosed diode only corresponding to that spanned by semiconductor zones 8_1 to 8_4, that is, that the "resistance layer" is bounded by junctions J2 and J3 (Appeal Br. 6–7), we find the arguments unpersuasive for the reasons expressed by the Examiner (Ans. 3–4). Further, because junction diode J3 is formed by both the zones 8_1 to 8_4 and the layer 4, the resistance R_0 in the corresponding circuit diagram with the corresponding connection below, not at, diode J3 makes manifest that the resistance layer with the resistance R_0 does not exclude semiconductor layer 4 as contended by Appellants. Mauder Fig. 1.

Appellants' further argument in the Reply Brief grounded on zones 8_1 to 8_4 and the pn-junctions formed between them and surrounding material (Reply Br. 2) is without persuasive merit where the Examiner's rejection is grounded on semiconductor layer 4 and the portions of semiconductor layer 5 (or 5′) extending between semiconductor zones 8_1 to 8_4 being normal ohmic material (Ans. 2–3).

Second, Appellants argue that because the semiconductor layer 4 of Mauder cannot be interpreted as being part of the so-called resistance layer, the semiconductor regions 8_1 to 8_4—separated from one another by portions of semiconductor layer 5 (or 5′)—Mauder also fails to teach or suggest a resistance layer directly on and uninterruptedly extending over and covering the back surface of the cathode. Appeal Br. 7. In the Reply Brief, Appellants continue to argue that "semiconductor zones 8_1 to 8_4 and first

semiconductor layer 4 . . . clearly cannot be interpreted as an **uninterruptedly extending resistance layer** as defined by independent claim 1." Reply Br. 2–3.

Appellants' argument grounded on Mauder not disclosing a resistance layer directly on the back surface of the cathode is addressed above. As to Appellants' further argument directed to the requirement that the resistance layer extend uninterruptedly (Appeal Br. 7, Reply Br. 2–3), it is wholly without persuasive merit both because it fails to address that semiconductor layer 4 does extend without interruption over cathode electrode 3 (Figs. 1, 2)[10] and because the rejection is grounded on those portions of 5 (or 5′) extending between semiconductor zones 8_1 to 8_4, not zones 8_1 to 8_4 themselves (Ans. 2–4).

Third, Appellants argue that there is no teaching or suggestion in either Mauder or Tolonics that the resistance layer is a carbon layer and that one of ordinary skill in the art would not replace the p-doped semiconductor zones 8_1 to 8_4 with a carbon layer because it would eliminate the pair of p-n junctions J2 and J3 from the Mauder device destroying its functionality. Appeal Br. 7–8. As set forth by Appellants, the structure of the Mauder semiconductor diode, particularly the particular biasing of junctions J1, J2, and J3, maintains the blocking capacity of the n-doped central region so that the semiconductor diode is not destroyed. Appeal Br. 8 (citing Mauder ¶¶ 2,

[10] To the extent Appellants are arguing that the recited resistance layer be uniform or homogenous, there is no basis for this in the recitation that the resistance layer is "disposed on and uninterruptedly extending over the entire back surface of the cathode emitter zone" (Claim 1) and unclaimed features cannot impart patentability to claims. *In re Hiniker Co.*, 150 F.3d 1362, 1369 (Fed. Cir. 1998); *In re Self*, 671 F.2d 1344, 1348 (CCPA 1982).

31–33). Appellants raise further arguments as to Tolonics (Reply Br. 3, citing Tolonics claims 1 and 4), which we find untimely as they are new and Appellants fail to establish why they could not have been raised in the Appeal Brief (*see generally* Appeal Br.; Reply Br.). We deem the arguments waived. *See* 37 C.F.R. § 41.41(b)(2).

Appellants' arguments are found unpersuasive of reversible error because they fail to address squarely the Examiner's relied on combination as set forth by the Examiner, including the determination that inclusion of a carbon resistor would provide the same or similar benefit of protecting the diode in extreme conditions as the structures in Mauder by restricting the current and power into the device and there is insufficient explanation in this record that the functionality of the Mauder semiconductor device would be destroyed. *Cf. DyStar Textilfarben Gmbh & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1364 (Fed. Cir. 2006) ("We will not read into a reference a teaching away from a process where no such language exists.").

Fourth, Appellants contend that the claimed thickness of the resistance layer (50 μm to 500 μm) is not taught or suggested by Mauder because, even if the first semiconductor layer 4 is considered part of the resistance layer, the "thickness is in a range from 3.2 to 50 μm" (Appeal Br. 9) and that the Specification establishes the criticality of the claimed thickness. Appeal Br. 9–10). Appellants rely on the Specification as supporting the criticality of the thickness and the criticality to rebut the Examiner's determination that the skilled artisan would have arrived at the claimed range through no more than routine experimentation. Appeal Br. 9–10 (citing Spec. ¶¶ 2, 26–29, 31–33, Table 1).

Appellants' contention that a thickness "in a range of 3.2 to 50 μm" does not render obvious a range of 50μm to 500 μm is without persuasive merit. A claimed range overlaps with a prior art range if the two ranges share a common endpoint. *In re Geisler*, 116 F.3d 1465, 1471 (Fed. Cir. 1997). And "the existence of overlapping or encompassing ranges shifts the burden to the applicant to show that his invention would not have been obvious." *In re Peterson*, 315 F.3d 1325, 1330 (Fed. Cir. 2003).

Appellants' reliance on the contention that the thickness has criticality is likewise without persuasive merit to rebut the Examiner's rejection grounded on the skilled artisan arriving at the claimed range through nothing more than routine experimentation. At the onset, on this record, we are directed to no persuasive evidence or argument that the thickness was not recognized as a result effective variable. *Generally*, Appeal Br.; Reply Br. The Examiner's reasonable determination that the thickness is a result effective variable as to, *inter alia*, the resistance layer diode reverse voltage and device thickness (Final Act. 4), as well as, operational characteristics including thermal capacity (Ans. 5–6), stands unrebutted. Likewise, we are directed to no evidence that anything more than routine experimentation would have been required to discover the optimum or workable ranges and, thus, it is only if the results of optimizing the variable are *unexpectedly* good that Appellants can rebut the prima facie case. *Geisler*, 116 F.3d at 1469.

On this record, having considered Appellants' proffered evidence, cited portions of the Specification, we find it wholly insufficient to rebut the prima facie case. It is well established that Appellants bear the burden of showing that the claimed invention imparts unexpected results, including when these are grounded on the criticality of a particular variable. *Geisler*,

116 F.3d at 1469–70 (citing *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990)). Further, "it is well settled that unexpected results must be established by factual evidence. 'Mere argument or conclusory statements in the [S]pecification does not suffice.'" *Geisler*, 116 at 1470 (quoting *In re De Blauwe*, 736 F.2d 699, 705 (Fed. Cir. 1984)). In this case, the range from 50 μm to 500 μm for which Appellants argue criticality is set forth as being "[t]ypical thickness values . . . [that] are readily compatible with the thermal capacity requirements referred to above" (Spec. ¶ 28) and the data proffered is, as the Examiner finds, limited to "several data points inside the claimed range, which do not show any unexpected or qualitatively different behavior or trends" (Ans. 5). *Cf. In re Tiffin*, 448 F.2d 791, 792 (CCPA 1971) ("[O]bjective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support."). As to the repeated contentions that the claimed range has criticality, they are without persuasive merit. *In re Pearson*, 494 F.2d 1399, 1405 (CCPA 1974) ("Attorney's argument . . . cannot take the place of evidence.").

For these reasons, we are not persuaded that the Examiner erred in rejecting independent claim 1 subject to Rejection I. As to the remaining claims subject to Rejection I and the further grounds of rejection (Rejections II–X), we likewise are not persuaded that the Examiner erred reversibly where Appellants rely on their arguments as to Rejection I.

Accordingly, we sustain the Examiner's decision.

CONCLUSION

The Examiner's rejections of claims 1, 8–14, 25–32, and 34–37 under 35 U.S.C. § 103(a) are AFFIRMED.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1).

AFFIRMED